# Exponential functions

Gleb Akkuratnov

# Introduction

- $y = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0$

- $y = x^2$

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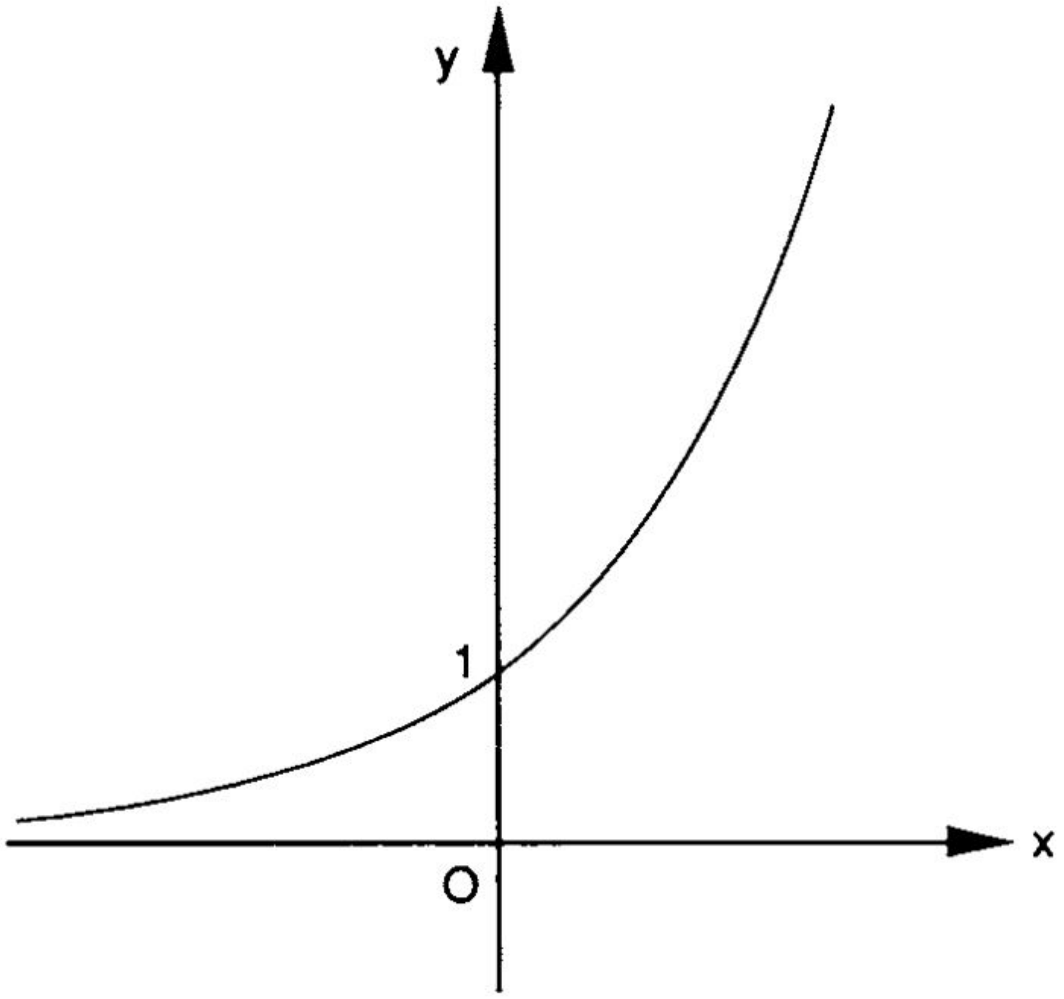
- $y = x^2 \Rightarrow y = 2^x \Rightarrow y = b^x$

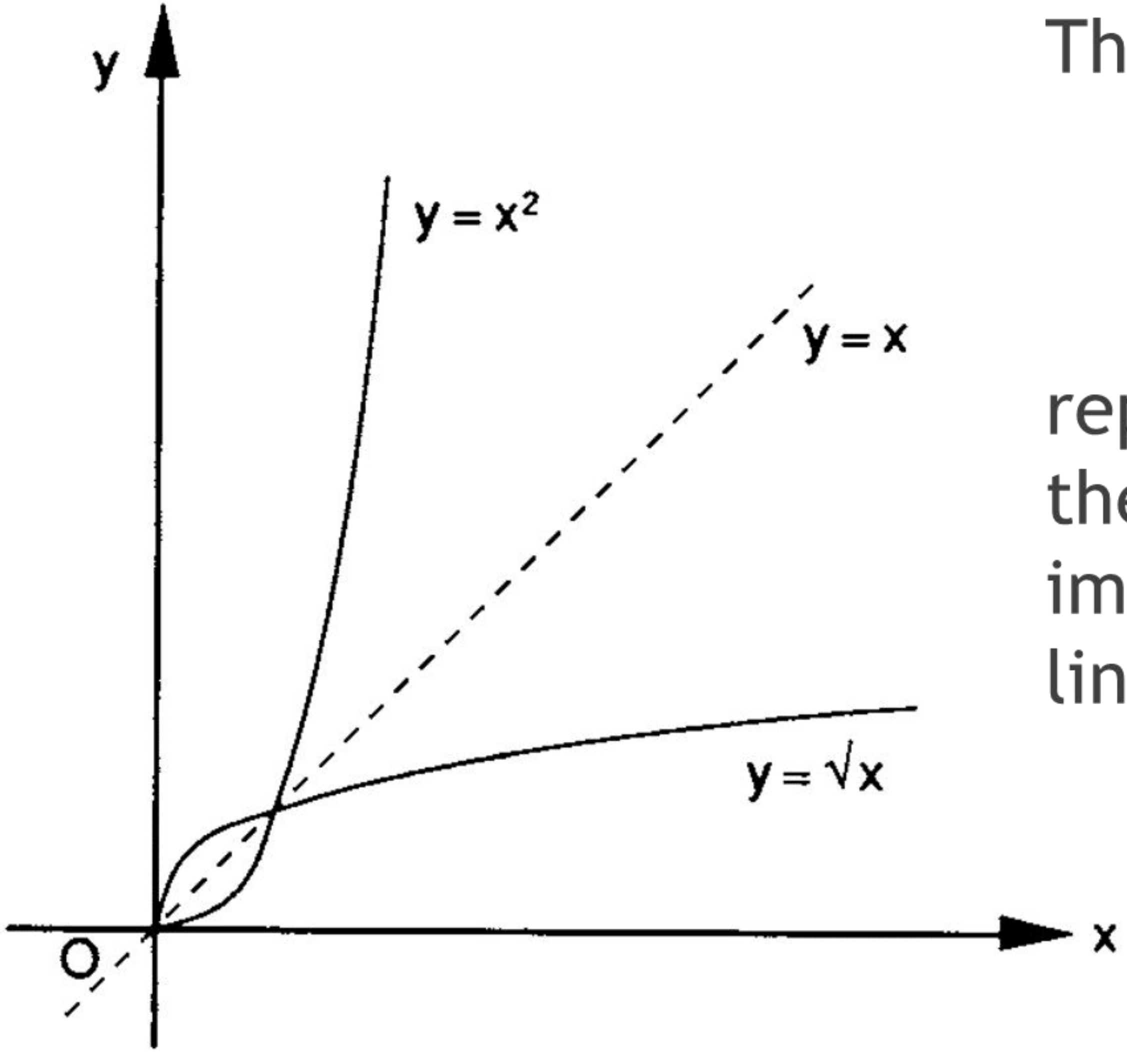
$u^v$ was introduced by Leibniz in 1695

# Graph of the exponential function




$$y = b^x$$

# Inverse functions




The equations

$$y = x^2$$

and

$$y = \sqrt{x}$$

represent inverse functions; their graphs are mirror images of each other in the line $y = x$.

# Inverse functions

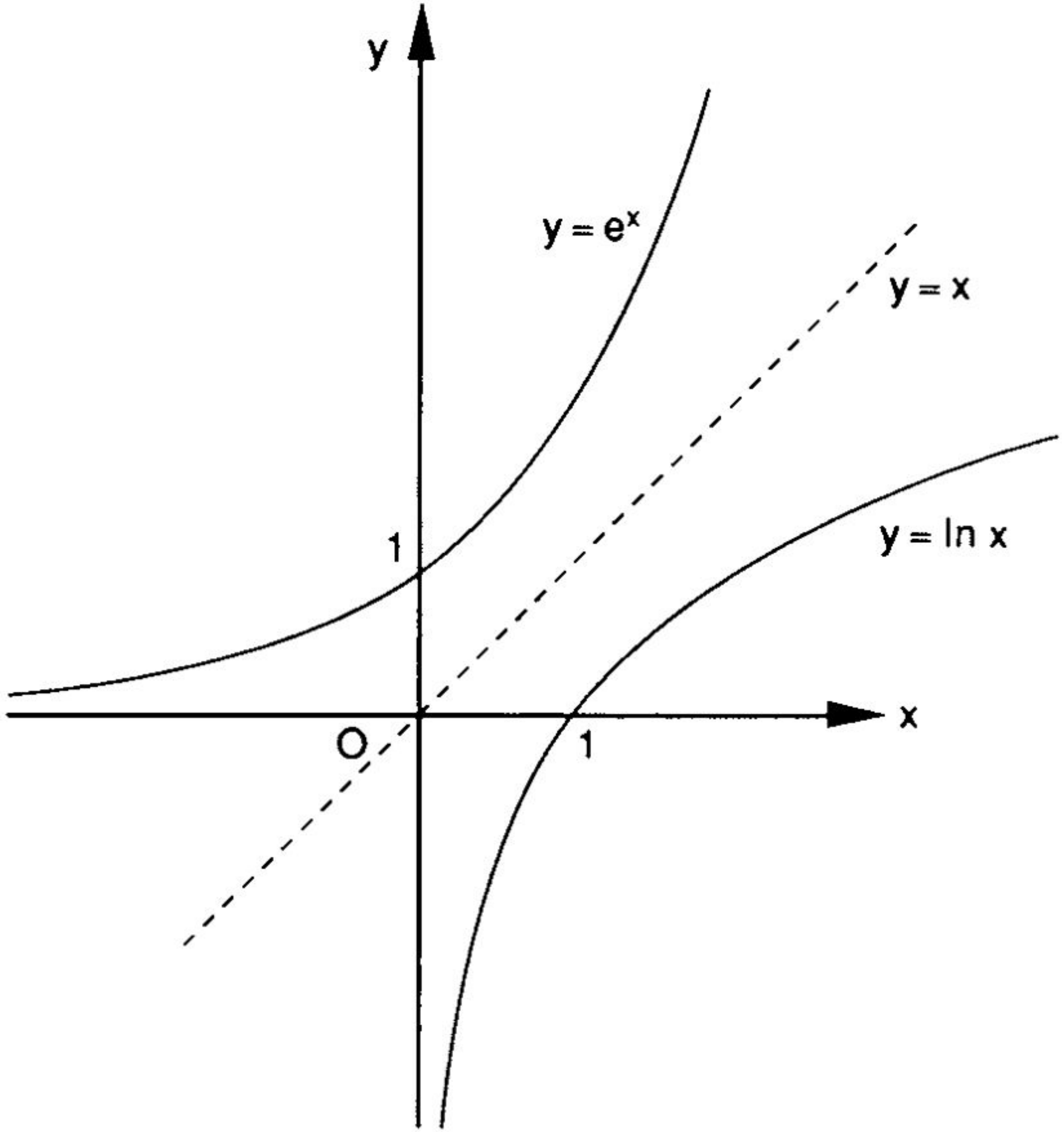
$$y = b^x$$

$$x = \log_b y$$

$$y = \log_b x$$

(or $y = \ln x$ if $b = e$)

# Inverse functions




The equations

$$y = e^x$$

and

$$y = \ln x$$

represent inverse functions.

# Derivative of an exponential function

1. $\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x}, \; y = b^x$

2. $\Delta y = b^{x+\Delta x} - b^x = b^x b^{\Delta x} - b^x = b^x(b^{\Delta x} - 1)$

3. $\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{b^x(b^{\Delta x}-1)}{\Delta x} \Rightarrow \frac{dy}{dx} = b^x \lim_{\Delta x \to 0} \frac{(b^{\Delta x} - 1)}{\Delta x}$

*If* $k = \lim_{\Delta x \to 0} \frac{(b^{\Delta x}-1)}{\Delta x}$, *then* $\frac{dy}{dx} = kb^x = ky$

# The end


Gleb Akkuratnov
E-mail: gucc1godma1l@gmail.com
Tel. +79302281488